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Antipodean albatross multi-threat risk assessment

Overview of approach and methods

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A multi-threat risk assessment will be carried out to identify and rank the relative impacts of various threats to the population of Antipodean albatross (Diomedea antipodensis antipodensis), endemic to New Zealand. The species is classified as Nationally Critical in New Zealand (under the New Zealand Threat Classification System; Robertson et al. 2017) based on a very high ongoing or predicted decline (>70%).

Introduction:

The Antipodean albatross breeds almost exclusively on Antipodes Island (New Zealand), but satellite tracks show that individuals forage throughout the Southern Pacific Ocean up to the Chilean coast (Tremblay-Boyer & Richard 2022, this ERSWG).

The Antipodean albatross population has been declining since 2007 (Elliott & Walker 2020). A leading threat previously identified for Antipodean albatross was fishing-induced mortality, being bycaught in surface-longline fisheries (Walker & Elliott 2006). However, a recent risk assessment of surface-longline fisheries to albatrosses and petrels in the Southern Hemisphere (Abraham et al. 2019; presented to ERSWG13) found that Antipodean albatross mortality from surface-longline bycatch on its own did not exceed the Population Sustainability Threshold (risk ratio median, 0.38, 95% credible interval 0.22–0.64). This assessment estimated capture rates by fisheries from observer data provided by Australia, Japan, New Zealand and South Africa.

Key threats identified for albatrosses and large petrels beyond bycatch include invasive species at nesting sites, climate change, and exposure to plastics or debris in the marine environment (Phillips et al. 2016). Antipodes Island has been predator-free since 2018 (Horn et al. 2019), so nest predation by invasive predators should have minimal impact on the population. Climate change, however, is likely to have had a recent and ongoing impact on demographic rates. For example, the Tasman Sea, where Antipodean albatross forage (particularly juveniles), has undergone one of the highest rates of warming globally (outside the polar regions; Oliver et al. 2017). In parallel, Edwards et al. (2017) found that age at first breeding was much higher in the recent period (2007 onwards) than previously, and suggested this might be related to nutritional stress. Nutritional stress has been linked to marine heatwaves in other seabird species (e.g. Jones et al. 2018, Tate et al. 2021).

Plastic pollution has not been formally recognised as a threat to Antipodean albatross by the Agreement on the Conservation of Albatrosses and Petrels (ACAP 2009) but a recent veterinary study of beach-cast albatross in New Zealand and Australia found that 5.6% had plastic debris in their gut, and that the debris were the cause of mortality in half of these cases (Roman et al. 2021). Mortality following plastic ingestion is likely to be under-reported, given few stranded albatrosses are encountered each year (and would not have a post-mortem examination). It is likely that plastics impact Antipodean albatross because its foraging distribution overlaps with one of the five great ``garbage patches'' in the world's oceans, where plastics accumulate at a considerable rate (e.g., Lebreton et al. 2018).

Overview of approach and methods:

Key threats contributing to the ongoing decline of the Antipodean albatross remain poorly characterised. As such, Fisheries New Zealand is undertaking a multi-threat risk assessment to quantify the likelihood of threats inducing population decline for this species and inform future management.

The risk assessment will use a demographic model of Antipodean albatross to allow the impact of each threat on the population trajectory to be determined. The demographic model is a Bayesian mark-recapture model, fitted to banding and resight data collected between 1994 and 2021 (Richard 2021). The effect of each threat on the demographic parameters will be estimated using a combination of quantitative methods and qualitative expert assessment. Once fitted, the model will be run in a forward simulation mode to allow the impact of the threat on the long-term population trajectory to be assessed.

The assessment of bycatch will follow the Spatially-Explicit Fisheries Risk Assessment Framework (SEFRA; Fisheries New Zealand 2020) approach, making the assumption that captures are related to the overlap between fishing effort and albatross distribution, and using observed captures and observed fishing effort to estimate the relationship.

Impacts will be considered either as direct removals from the population (in individuals), or as a change in demographic parameters (in parameter units), e.g. for climate change. The population model will allow the conversion between the two. The scenarios used to drive changes in demographic parameters will be informed by a literature review and further reviewed by an expert workshop. Key threats included in the risk assessment are detailed below.

Fisheries bycatch: Recent research using fishing effort data from the Global Fishing Watch database documented that surface-longline fisheries had the highest level of interaction with Antipodean albatross compared with other fishing gears (Bose & Debski 2020). This analysis will thus focus on surface-longline fishing effort based on a dataset of surface-longline fishing effort recently collated by the National Institute of Water and Atmospheric research (Figure 1). This dataset, together with Antipodean albatross distribution assembled from tracking data (Figure 2; from Tremblay-Boyer & Richard 2022, this ERSWG) will be used to assess the spatial interaction between Antipodean albatross and surface longliners. The total number of incidental captures of Antipodean albatross will be estimated by assuming that it is proportional to the overlap between the density of the population and the fishing effort, scaled by the vulnerability to fishing effort.

Vulnerability to fishing effort will be estimated for multiple fishing fleets following the approach in Abraham et al. (2019). Collaborations with national scientists with access to observer datasets for key member countries will be sought out. There will be the option to either provide access to a relevant subset of the observer dataset for the authors to perform the analysis of Antipodean albatross vulnerability to fishing, or for programming code to be shared with the national scientists for the analysis to be run locally by them. This collaborative approach was applied successfully in other projects to gather data that would have not been shared otherwise due to their sensitivity (Neubauer 2021).

Variability in interaction hotspot will be quantified using the approach developed in Tremblay-Boyer & Richard (2022) and propagated through other components of the analysis.

Mortality from plastic ingestion: The vulnerability of Antipodean albatross to marine plastics will be parameterised based on other studies documenting plastic ingestion in seabirds. For example, the recent study by Roman et al. (2021) estimated the proportion of mortality due to plastic ingestion when plastic was present in the gut of by-caught and beachcast albatrosses in New Zealand and Australia. The probability of plastic being present in the gut given plastic concentration in the water column will be parameterised from studies of the rate of plastic ingestion for albatross and petrels in other locations with known plastic concentrations (e.g. the Hawaiian Islands, Rapp et al. 2017). A dataset of plastic concentration in the marine environment (from Eriksen et al. 2014; Figure 3) will be used to quantify the spatial interaction with Antipodean albatross.

Climate change: A climate envelope model (or similar) will be generated based on tracking, oceanographic, and climate data. Climate envelopes allow characterisation of the distribution of environmental variables that are associated with a species' distribution. Once the envelope has been defined, hindcasting can be performed to track changes in the location of the distribution in previous years to see the extent to which changing climate conditions explain variability in Antipodean albatross distribution. If possible, we will relate changes in annual demographic rates estimated from the population model, to oceanographic conditions in the foraging distribution of Antipodean albatross. These relationships will be used to inform scenarios of climate change impact on demographic rates for use in the risk assessment.

Nutritional stress: Given previous findings of declines in demography rates unexplained by fishing mortality (Edwards et al. 2017), a literature review of Antipodean albatross diet and nutrition will be performed, supplanted when needed by findings for other related species. This will allow the generation of non-fishery threat scenarios linked to nutrition to use as input to the simulation model. Necropsy records will also be accessed to ensure all key sources of non-fishery threats are considered.

Sporadic threats: Other infrequent but high-risk sporadic threats will also be included in the assessment, such as oil spills in the foraging range and landslides at the breeding colony. Although the location of future potential oil spills cannot be determined, different scenarios may be considered, impacting adult and juvenile survival, at regular intervals. Oil spill scenarios will be designed based on the dataset made available by the International Tanker Owners Pollution Federation (ITOPF). Also, extreme weather events may cause landslides at the breeding colony, such as in January 2014 (Chilvers & Hiscock 2019). These landslides may lead to a decrease in habitat suitable for breeding (affecting the number of breeding pairs or the probability of breeding), and reduced breeding success. Scenarios of extreme weather events may be considered with various intensities and frequencies of occurrence.

References

Abraham, E., Richard, Y., Walker, N., Gibson, W., Daisuke, O., Tsuji, S., and others (2019). Assessment of the risk of surface longline fisheries in the Southern Hemisphere to albatrosses and petrels, for 2016. Prepared for the 13th meeting of the Ecologically Related Species Working Group (ERSWG13) of the Commission for the Conservation of Southern Bluefin Tuna (CCSBT).

Agreement on the Conservation of Albatrosses and Petrels. 2009. ACAP Species assessment: Antipodean Albatross Diomedea antipodensis. Downloaded from http://www.acap.aq on 5 October 2021.

Bose, S. & Debski, I. (2020). Antipodean albatross spatial distribution and fisheries overlap 2019. Department of Conservation Technical Report. 23 p.

Chilvers, B. L. & Hiscock, J. A. (2019). Significant decline of endangered Antipodes island penguins: Is extreme weather an additional impact? Aquatic Conservation: Marine and Freshwater Ecosystems, 29 (4), 546–553.

Edwards, C.T.T.; Roberts, J.O.; Walker, K.; Elliott, G. (2017). Quantitative modelling of Antipodean wandering albatross. New Zealand Aquatic Environment and Biodiversity Report No. 180. 32 p.

Elliott, G. & Walker, K. (2020). Antipodean wandering albatross: Satellite tracking and population study - Antipodes Island 2020. Report prepared for the Department of Conservation. Retrieved from https://bit.ly/2SceRwt

Eriksen M, Lebreton LC, Carson HS, Thiel M, Moore CJ, Borerro JC, Galgani F, Ryan PG, Reisser J. Plastic pollution in the world's oceans: more than 5 trillion plastic pieces weighing over 250,000 tons afloat at sea. PloS one. 2014 Dec 10;9(12):e111913.

Fisheries New Zealand (2020). Aquatic Environment and Biodiversity Annual Review 2019–20. Compiled by the Aquatic Environment Team, Fisheries Science and Information, Fisheries New Zealand, Wellington New Zealand. 765 p.

Horn, S., Greene, T., & Elliott, G. (2019). Eradication of mice from Antipodes Island, New Zealand. *Island invasives: scaling up to meet the challenge*, *131*, 136.

Jones, Timothy, et al. "Massive mortality of a planktivorous seabird in response to a marine heatwave." *Geophysical Research Letters* 45.7 (2018): 3193-3202.

Lebreton, L., Slat, B., Ferrari, F., Sainte-Rose, B., Aitken, J., Marthouse, R., ... & Reisser, J. (2018). Evidence that the Great Pacific Garbage Patch is rapidly accumulating plastic. *Scientific reports*, *8*(1), 1-15.

Neubauer, P., Large, K., Brouwer, M., S. and Kai, Tsai, W.-P. & Liu, K.-M. (2021). Input data for the 2021 South Pacific Blue Shark stock assessment. In: WCPFC Scientific Committee 17th Regular Session. WCPFC-SC17-2021/SA-IP-18, Electronic Meeting.

Oliver, E. C., Benthuysen, J. A., Bindoff, N. L., Hobday, A. J., Holbrook, N. J., Mundy, C. N., & Perkins-Kirkpatrick, S. E. (2017). The unprecedented 2015/16 Tasman Sea marine heatwave. *Nature communications*, *8*(1), 1-12.

Phillips, R. A., Gales, R., Baker, G. B., Double, M. C., Favero, M., Quintana, F., ... & Wolfaardt, A. (2016). The conservation status and priorities for albatrosses and large petrels. *Biological Conservation*, *201*, 169-183.

Rapp, D. C., Youngren, S. M., Hartzell, P., & Hyrenbach, K. D. (2017). Community-wide patterns of plastic ingestion in seabirds breeding at French Frigate Shoals, Northwestern Hawaiian Islands. *Marine Pollution Bulletin*, *123*(1-2), 269-278.

Richard, Yvan (2021). Integrated population model of Antipodean albatross for simulating management scenarios, 31 pages. Technical report prepared for Department of Conservation – June 2021.

Robertson, H.A.; Baird, K.; Dowding, J.E.; Elliott, G.P.; Hitchmough, R.A.; Miskelly, C.M.; McArthur, N.; O'Donnell, C.F.J.; Sagar, P.M.; Scofield, R.P.; Taylor, G.A. 2017: Conservation status of New Zealand birds, 2016. New Zealand Threat Classification Series 19. Department of Conservation, Wellington. 23 p.

Roman, L., Butcher, R. G., Stewart, D., Hunter, S., Jolly, M., Kowalski, P., ... & Lenting, B. (2021). Plastic ingestion is an underestimated cause of death for southern hemisphere albatrosses. *Conservation Letters*, *14*(3), e12785.

Tate, Heidi M., et al. "Interannual measures of nutritional stress during a marine heatwave (the Blob) differ between two North Pacific seabird species." *Conservation Physiology* 9.1 (2021): coab090.

Walker, K., Elliott, G., & Nicholls, D. (2006). At-sea distribution of Gibson's and Antipodean wandering albatrosses, and relationships with longline fisheries. *Notornis*, *53*(3), 265.

Figures

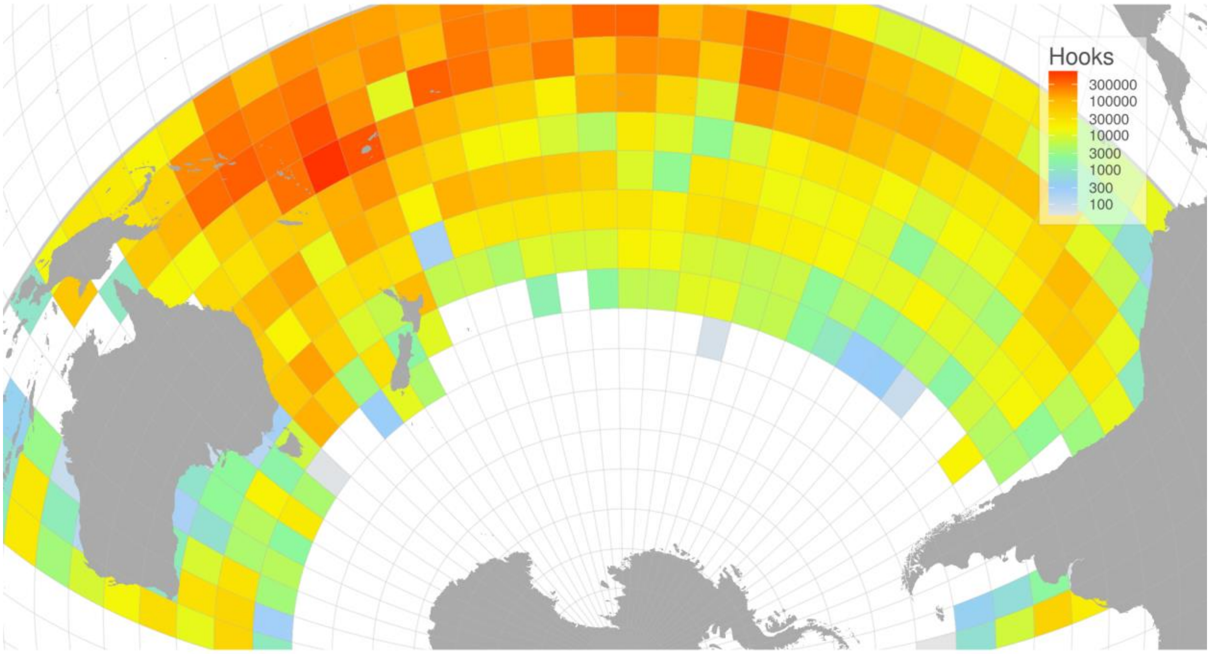

Figure 1. Mean annual surface-longline fishing effort (in hooks) between 1997 and 2019, coloured on a logarithmic scale.

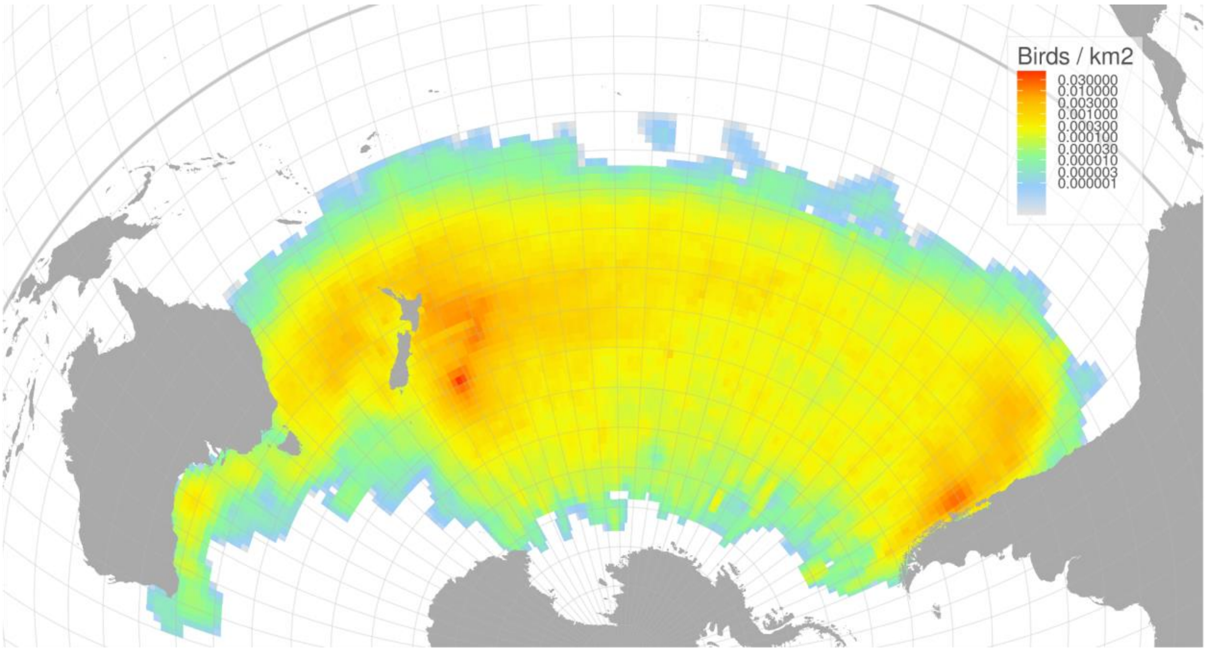

Figure 2. At-sea distribution of Antipodean albatross from tracking data, after combining the distribution of each demographic stratum across all years between 1997 and 2021, weighted by the number of birds in each stratum obtained from an integrated population model. The colour is shown on a logarithmic scale.

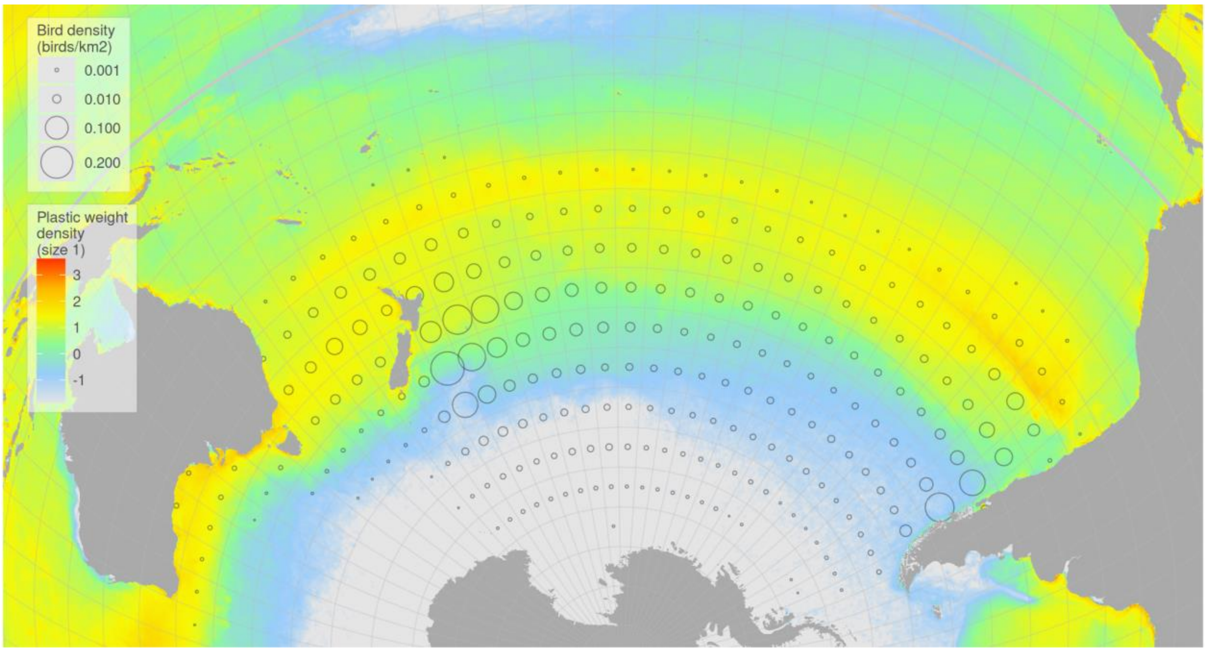

Figure 3: Spatial density of microplastics (colours), overlapped with the Antipodean albatross density at a 5 degree x 5 degree resolution (points)